FISHING PRESSURE AND FISH HARVEST AT LAKE MONROE, 2000

Fish Management Report

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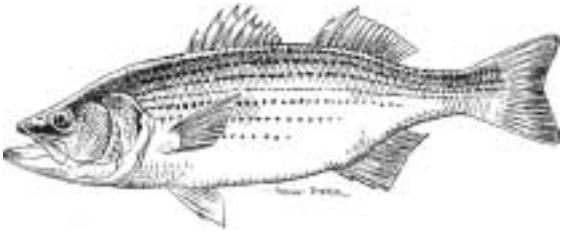

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INTRODUCTION

Lake Monroe is a 10,750 acre flood control reservoir located in Brown and Monroe Counties southeast of Bloomington, Indiana. It is the largest lake in Indiana, and recreational activities such as boating and fishing are very important. There are nine publicly-owned boat ramps located around the lake. Access is also available at several privately-owned recreational facilities such as boat rentals, sports shops, marinas, and campgrounds. Lake Monroe serves as the primary water supply for the city of Bloomington.

Since impoundment in 1965, Lake Monroe has been managed primarily for largemouth bass and panfish fishing. A 14-inch minimum size limit on largemouth bass has been in effect since 1973. As often occurs at new reservoirs, Monroe provided excellent fishing for several years after impoundment. Fishing quality began to level off with increased numbers of less desirable species such as longear sunfish, yellow bass, carp and gizzard shad. Since about 1982, the lake's fish community has been characterized by an overabundance of forage fish and too few predator fish.

Fish management activities at Lake Monroe have included several supplemental stockings of predator species. Early stockings included both northern pike, and walleye, but were for the most part unsuccessful. One stocking of 4,500, 10 - 18 inch pike in 1979 did provide moderate success with some returns to anglers. More recent stockings have included both walleye and hybrid striped bass (Table 1). The intent of these stockings has been to provide additional fishing opportunities and utilize some of the surplus forage fish, particularly gizzard shad.

From April 1 to October 31, 2000, an angler survey was conducted at Lake Monroe. The objectives of this survey were to measure fishing pressure and fish harvest, evaluate angler interest in and harvest of supplementally stocked walleye and hybrid striped bass, and determine if the stocking programs are cost-effective. This report summarizes the results of that survey and provides recommendations for future work.

METHODS

The angler survey was conducted using a non-uniform probability design. This sampling design was originally developed in Missouri and has successfully been used in the past to conduct angler surveys at Brookville and Patoka Reservoirs as well as Lake Monroe.

Probabilities for each of nine boat ramps and two tailwater fishing areas (Table 2) were calculated from 1993 Army Corps of Engineers car count data as well as estimates from previous surveys. Probabilities for two other popular bank fishing areas were estimated. Several additional access points exist at Lake Monroe, but these sites were not sampled due to relatively low usage or because they were not included in 1991.

Table 1. Walleye (WAE) and hybrid striped bass (HSB) stockings at Lake Monroe, 1982 through 2000.

Year	Species	Number	No./Acre	Size
1982	WAE	73,700	6.8	1 - 2"
1985	WAE	8,300	0.8	3"
1986	WAE	48,147	4.5	1 - 2"
1987	WAE	37,853	3.5	3"
1988	WAE	573,094	53.3	1 - 2"
1989	WAE	524,362	48.8	1 - 2"
1990	WAE	642,392	59.8	1 - 2"
1990	WAE	11,255,325	1,047	Fry
1991	WAE	461,102	42.9	1.5 - 2.5"
1992	WAE	541,766	50.4	1 - 2"
1993	WAE	523,720	48.7	1 - 2"
1994	WAE	441,284	41.0	1 - 2"
1995	WAE	538,467	50.1	1 - 2"
1996	WAE	746,075	69.4	1 - 2"
1997	WAE	801,791	74.6	1 - 2"
1998	WAE	285,675	26.6	1 - 2"
1999	WAE	563,030	52.4	1 - 2"
2000	WAE	547,347	50.9	1 - 2"
1983	HSB	58,282	5.4	1 - 2"
1984	HSB	100,000	9.3	Fry
1984	HSB	44,450	4.1	2"
1985	HSB	107,000	10.0	1 - 2"
1986	HSB	53,850	5.0	1 - 2"
1988	HSB	10,710	1.0	2"
1989	HSB	75,250	7.0	2"
1990	HSB	53,760	5.0	1 - 2"
1991	HSB	53,750	5.0	1 - 2"
1992	HSB	54,716	5.1	1 - 2"
1993	HSB	90,306	8.4	1 - 2"
1994	HSB	6,618	0.6	2.3"
1995	HSB	*		
1996	HSB	51,500	4.8	2.2"
1997	HSB	108,112	10.1	1.2"
1998	HSB	161,250	15.0	1.5"
1999	HSB	53,750	5.0	1.5"
2000	HSB	5,732	0.5	2 - 3"

Table 2. Sampling probabilities assigned to Lake Monroe access sites, April 3 to October 31, 1994.

Site	Access Type	Sampling Probability April, May	Sampling Probability June - October
Salt Creek	ramp	0.061	0.062
Fairfax	ramp	0.104	0.105
Hardin Ridge	ramp	0.068	0.069
Allens Creek	ramp	0.020	0.021
Moores Creek	ramp	0.052	0.053
Paynetown	ramp	0.306	0.307
Cutright	ramp	0.225	0.226
Pinegrove	ramp	0.037	0.038
Crooked Creek	ramp	0.018	0.019
Tailwater (North side)	shore	0.058	0.059
Tailwater (South side)	shore	0.025	0.026
Cutright loop	shore	0.014	0.015
Dam face	shore	0.012	***

*** Not sampled.

From April through August, the fishing day was divided into three periods: 6 a.m. to 1:30 p.m., 2 p.m. to 9:30 p.m., and 10 p.m. to 5:30 a.m. Fishing activity probabilities assigned to these periods were 0.20, 0.70, and 0.10 respectively. Due to relatively low usage, the dam face was not sampled after May. During September and October, the fishing day was divided into two periods: 6 a.m. to 1:30 p.m. and 2:00 p.m. to 9:30 p.m. Fishing activity probabilities assigned to weekend days and weekdays were 0.051 and 0.025 respectively.

Two creel clerks were employed for the survey. Periods worked were assigned randomly based on site, day of week, and time of day probabilities. Each clerk normally worked ten days per two-week period. Anglers were interviewed at the end of their fishing trips. Interview data included length of trip, number in party, county of residence, species sought, number and length (nearest 0.5 inch) of fish harvested, and number of largemouth bass, hybrid striped bass, and walleye caught and released. Anglers were asked if they were satisfied with their fishing trip and if they favored the current 14-inch minimum size limit on walleye. Clerks also attempted to record the number of anglers who completed their trips but were not interviewed.

Fishing pressure and fish harvest were estimated by month using methods similar to those described by Glander and Ball (1982). These estimates represent the fishing activity which occurred at the thirteen sites which were sampled, and do not include fishing activity at other sites on the lake. Tailwater fishing was included in the totals due to the high amount of

fishing pressure that occurs there, as well as the high harvest of walleye and hybrid striped bass. The tailwater fishery is a direct result of the supplemental predator stocking program currently conducted in the lake proper, and is therefore an important estimator of the success of this program. Weights of fish harvested were estimated using average weights of fish at Lake Monroe, district average weights, or if necessary, length weight equations (Murphy and Willis 1996). Data on county of residence was not expanded.

RESULTS AND DISCUSSION

Fishing Pressure and Angler Preference

From April 3 to October 31, 2000, an estimated 81,104 anglers fished an estimated 362,447 (33.7 hours/acre) hours at Lake Monroe (Table 3). This is somewhat lower than fishing pressure observed at Monroe in 1994 (56.4 hours/acre) (Andrews 1995) and similar to pressure observed at Patoka in 2000 (38.8 hours/acre) (Carnahan 2001). Additionally, Lake Monroe use data obtained from the Army Corp of Engineers Office also documented a decrease in reservoir use from 1994 to 2000. Monroe Lake monthly fishing pressure was highest in June followed by May, April, and July. Fishing pressure was relatively low during the months of August, September, and October.

As in previous angler surveys, largemouth bass was the most sought species at Lake Monroe in 2000. Crappie was the second most sought species followed by “anything”, hybrid striped bass, walleye, channel catfish, and bluegill. Anglers targeting species in combination accounted for an additional 8.6% of anglers. The high percentage of largemouth bass fishing reflects the importance of this species to the Lake Monroe fishery.

Table 3. Estimated number of anglers and fishing pressure at Lake Monroe, April 3 to October 31, 2000.

Month	Number of Anglers	Fishing Pressure (hrs.)
April	11,519	51,327
May	17,388	70,483
June	21,366	106,963
July	11,406	50,984
August	7,852	32,084
September	6,127	25,420
October	5,446	25,186
TOTALS	81,104	362,447

Angler preference for hybrid striped bass and walleye increased by 86% and 61%, respectively, from the 1994 angler survey making these stocked predators the third and

fourth most popular species among anglers (Table 4). These two species ranked 8th (walleye) and 11th (hybrid striped bass) among anglers in 1994.

Table 4. Species sought by anglers fishing at Lake Monroe during 2000.

Species Sought	Percent of Anglers
Largemouth bass	27.8
Crappie	15.2
Hybrid striped bass	11.6
Walleye	5.9
Channel catfish	5.0
Bluegill	4.0
Hybrid striped bass/walleye	3.6
Bluegill/crappie	2.9
Largemouth bass/panfish	1.0
Largemouth bass/walleye	0.5
Walleye/crappie	0.3
Channel catfish/crappie	0.3
Anything	21.9

Fish Harvest

Anglers harvested an estimated 141,101 fish (13.1/acre) weighing a total of 71,877 pounds (6.7 pounds/acre) at Lake Monroe. In comparison to 1994, 15% fewer fish were harvested by number with a decrease of 25% by weight. Crappie were the most numerous species harvested followed by bluegill, yellow bass, hybrid striped bass, channel catfish, walleye, and largemouth bass (Table 5). Crappie dominated the catch by weight, followed by hybrid striped bass, bluegill, walleye, largemouth bass, and yellow bass.

Table 5. Estimated number and weight of fish harvested at Lake Monroe, April 3 to October 31, 2000.

	Harvest		Yield	
Species	Number	Percent	Weight (lbs.)	Percent
Crappie*	85,258	60.4	31,650	44.0
Bluegill	29,122	20.6	6,642	9.2
Yellow bass	9,406	6.7	2,020	2.8
Hybrid striped bass	8,757	6.2	13,533	18.8
Channel catfish	4,131	2.9	8,905	12.4
Walleye	2,203	1.6	3,646	5.1
Largemouth bass	1,178	0.8	3,159	4.4
Others**	1,046	0.7	2,322	3.2
Totals	141,101		71,877	

*Includes primarily white but also some black crappie.
**Includes redear sunfish, yellow perch, flathead catfish, blue catfish, freshwater drum and common carp.

Crappie accounted for 60.4% of the harvest by number and 44.0% by weight. An estimated 85,258 crappie were harvested at a rate of 0.235 fish/hour (Table 6). The average length of crappie harvested was 9.0 inches compared to 8.0 inches in 1994. Preferred size crappie (those 10 inches and larger) comprised 27.8% of the harvest compared to 9.3% in 1994 and 4.8% in 1991 (Andrews 1992). Harvested crappie ranged from 5.0 to 16.0 inches. Crappie have supplanted bluegill as the dominant species in the harvest at Lake Monroe.

Table 6. Estimated harvest rates and length of fish harvested at Lake Monroe, April 3 to October 31, 2000.

Species	Harvest Rate (fish/hour)	Total Length (in.) Mean	Range
Crappie	0.235	9.0	5.0 - 16.0
Bluegill	0.080	6.8	3.0 - 10.0
Yellow bass	0.026	7.2	5.0 - 13.0
Hybrid striped bass	0.024	12.7	6.0 - 27.0
Channel catfish	0.011	18.3	12.0 - 33.0
Walleye	0.006	16.8	13.5 - 26.0
Largemouth bass	0.003	16.5	11.5 - 24.0

An estimated 29,122 bluegill were harvested comprising 20.6% of the harvest by number and 9.2% by weight. The average length of harvested bluegill was 6.8 inches and ranged from 3.0 to 10.0 inches in length which is very similar to the 1994 data. Bluegill were harvested at the rate of 0.080 fish/hour.

Yellow bass accounted for 6.7% of the harvest by number and 2.8% by weight. An estimated 9,406 yellow bass were harvested averaging 7.2 inches in length. Yellow bass were harvested at the rate of 0.026 fish/hour.

Hybrid striped bass ranked fourth (6.2%) in the harvest by number and second (18.8%) by weight. An estimated 8,757 hybrids weighing a total of 13,533 pounds were harvested during the survey. The average length of harvested hybrids was 12.7 inches and ranged from 6.0 to 27.0 inches in length (Figure 1). Considerably more small hybrids were harvested during this survey than in past angler surveys. The harvest rate for hybrid striped bass was 0.024 fish/hour. An additional 22,955 hybrids were caught and released of which 459 were 17 inches or larger.

An estimated 4,131 channel catfish were harvested weighing an estimated 8,905 pounds. Harvested channel catfish averaged 18.3 inches in length and ranged from 12.0 to 33.0 inches. The channel catfish harvest rate was 0.011 fish/hour. In addition to channel catfish, anglers harvested blue and flathead catfish.

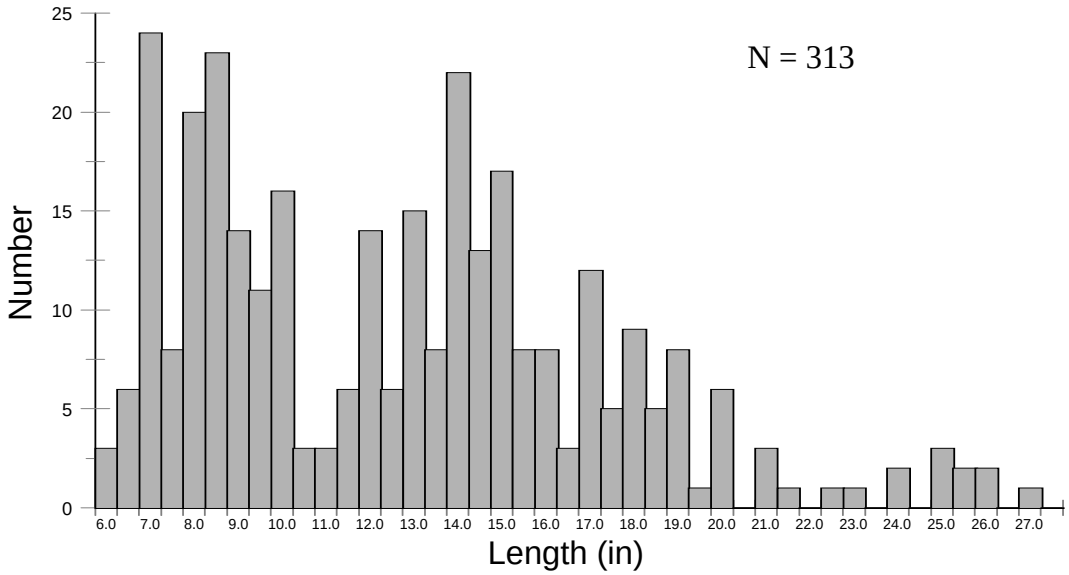

Figure 1. Length frequency of hybrid striped bass harvested at Lake Monroe during 2000.

An estimated 2,203 walleye were harvested at Lake Monroe. An additional 5,198 walleye were caught and released of which at least 504 were of legal size (14 inches or larger). The average length of walleye harvested was 16.8 inches and ranged from 13.5 to 26.0 inches in length (Figure 2). The harvest rate for walleye was 0.006 fish/hour. Most of the walleye harvested came from the main lake (87%), while an additional 13% were harvested in the tailwater area.

An estimated 1,178 largemouth bass were harvested with an additional 27,619 bass caught and released of which 8,289 were 14 inches or larger. It should be noted that only legal bass released were reported on some occasions. The average length of harvested largemouth bass was 16.5 inches and ranged from 11.5 to 24.0 inches. Both harvest and number of bass caught and released declined by roughly half compared to the 1994 creel survey. The largemouth bass harvest rate was 0.003 fish/hour compared to 0.005 fish/hour in 1994. Most bass anglers at Lake Monroe practice catch and release. Without the high degree of catch and release, harvest could have a significant impact on the quality of the bass population.

Other fish harvested at Lake Monroe included flathead catfish, blue catfish, redear sunfish, freshwater drum, carp, and yellow perch. These fish combined accounted for 0.7% of the harvest by number and 3.2% by weight.

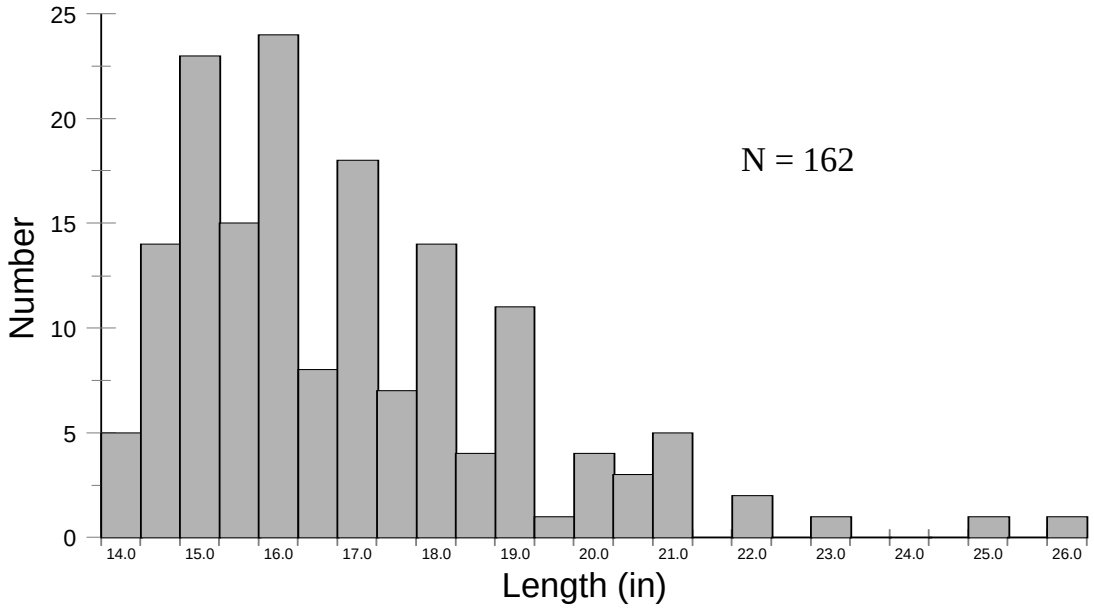

Figure 2. Length frequency of walleye harvested at Lake Monroe during 2000.

Angler Satisfaction and Opinions on Management

As part of each interview, anglers were asked if they were satisfied with their overall fishing trip experience. Of anglers who answered the question, 84.6% indicated satisfaction while 15.4% were dissatisfied. This suggest that the majority of anglers were satisfied with their fishing trip. It should be noted, however, that fishing quality may or may not be a contributing factor to angler trip satisfaction. Additionally, several anglers offered unsolicited comments during the interview (Appendix 2).

Anglers were also asked if they favored the current 14-inch minimum size limit for walleye. Of anglers responding, 98.7% supported the regulation while 1.3% were opposed. Many of the unsolicited comments were for an increased walleye minimum size limit.

Origin of Anglers

Anglers fishing at Lake Monroe came from 79 of Indiana's 92 counties as well as out of state (Appendix 3). Most anglers (40.0%) came from Monroe and Marion Counties. Other counties representing 100 or more fishing parties included Lawrence, Bartholomew, Morgan and Johnson. Approximately 2.5% of anglers came from out-of-state.

Economic Value of the Fishery

Anglers made an estimated 81,104 fishing trips to Lake Monroe during the creel period. The U.S. Department of the Interior, Fish and Wildlife Service (1998) determined that anglers spent an average of $50.00 for each fishing trip in Indiana during 1996. This figure includes expenditures for food, lodging, transportation, equipment, and license fees. Using this figure, the estimated economic value of the Lake Monroe fishery from April 3 to October 31, 2000 was 4.1 million dollars.

Anglers fishing for walleye accounted for 5.9% of the total, while another 4.5% were fishing for walleye in combination with another species. If we assume that anglers who fished for walleye in combination spent half of their angling time targeting walleye, this yields an additional 2.3% of anglers. Looking at the total of anglers targeting walleye, 6,423 trips were made to fish for walleye. The estimated minimum value of the walleye fishery from April 3, to October 31, 2000 was $321,150. At an average stocking rate of 50 walleye fingerings per acre, the estimated cost of stocking Lake Monroe with walleye is $37,625 per year. This figure is based on the 1999 average cost ($0.07) to raise and stock a walleye fingerling (Fisheries Section, Indiana Department of Natural Resources 1999). If the stocking costs are compared to the economic value of the walleye fishery, the cost-benefit ratio for the walleye stocking program at Lake Monroe is 1:8.5.

Anglers fishing for hybrid striped bass accounted for 11.6% of total anglers. An additional 3.6% were fishing for hybrids in combination with walleye. Using the previous analysis, the economic value of the hybrid fishery for April 3 to October 31, 2000 was $532,475. The current annual stocking rate for Lake Monroe is five hybrid striper fingerlings per acre. The cost for raising these fish in 1999 was $0.02 per fingerling for a total cost of $1,075 for the stocking. Using the previous formula, the cost-benefit for the hybrid striped bass stocking program is 1:495.3.

CONCLUSIONS AND RECOMMENDATIONS

Overall fishing pressure at Lake Monroe decreased somewhat from the previous angler survey. The fishing pressure decrease could be related to changes made in the probabilities used to determine which boat ramps the clerks worked. Probability changes were based on changes in angler use patterns observed at the lake. The probabilities continue to be the weakest link in non-uniform probability angler surveys. Future angler surveys may benefit from an access use survey of the ramps prior to assigning probabilities.

Largemouth bass continue to be the most sought species among Lake Monroe anglers. The number of bass caught and released decreased slightly from the 1994 survey.

The decrease in success could reflect changes in the water management at the reservoir made by the Army Corps of Engineers. Water levels at Monroe were unusually stable in 2000 following six years of high variability. This stability resulted in a large increase in aquatic vegetation coverage which likely altered largemouth bass behavior and habitat usage. Anglers may have been slow to adapt to this change. Most bass anglers at Monroe continue to release the bass they catch which should insure continued quality bass angling at the reservoir. A total of 43 different bass tournaments were scheduled at Lake Monroe during the 2000 fishing season. These tournaments involved anywhere from 25 to 175 boats each. Several of the tournaments were regular events that took place each week.

Crappie have surpassed bluegill as the second most popular species among Lake Monroe anglers. The crappie population appears to be improving based on the increased number and size of fish harvested compared to the 1994 survey.

The percentage of anglers targeting walleye has increased since the previous survey from 2.3% to 5.9%. An additional 4.5% of anglers sought walleye in combination with another species. Walleye are now the fourth most sought species at Lake Monroe. Despite the increased percentage of walleye anglers, harvest of walleye actually declined from the previous survey. The success criteria for the statewide walleye stocking program prior to implementation of the 14-inch minimum size limit was to provide an annual harvest of one fish or one pound per acre. Because Lake Monroe is stocked at half the normal rate of walleye (50/acre), the success criteria would be reduced by half. Walleye were harvested at 0.2 fish/acre and 0.3 pounds/acre during the survey period. While this is below the target objectives, the harvest rate fails to take into account the 5,198 walleye that were released of which at least 504 were greater than 14 inches in length. An alternative success criteria is a minimum walleye fishing preference of 5% in combination of with a minimum catch rate of 0.1 fish/hour for anglers targeting walleye. Lake Monroe had a walleye preference catch of 0.169 for the 5.9% of anglers specifically targeting walleye and therefore successfully met this criteria. The walleye stocking program at Lake Monroe was also successful from a cost-benefit standpoint.

The objective of the statewide hybrid striped bass program is to provide an annual harvest rate of one hybrid striped bass per acre. While Lake Monroe did not meet this objective (0.8 bass/acre), anglers released an additional 22,955 hybrids of which at least 459 were 17 inches or larger. In addition, hybrid striped bass have risen to the third most popular sport fish at Lake Monroe and account for 11.6% of angling. The hybrid striped bass stocking program is also highly successful from a cost-benefit outlook. A recent trend observed since the last angler survey is the harvest of small hybrid striped bass. The average length of

harvested hybrids dropped from 18.9 inches in 1994 to 12.7 inches in 2000. Anglers appear to have trouble distinguishing between small hybrids and yellow bass. Misidentification problems early in the survey season may have troubled the clerks as well. Regardless, the length frequency data for harvested hybrid striped bass indicates that fish as young as age 1 are being harvested at relatively high levels. This high level of exploitation is likely reducing the number of larger fish available to anglers.

Both predator stocking programs appear to be well received by anglers and relatively successful from a harvest aspect. The predator stockings may be benefitting the reservoir in other ways as well. The increase in predators appears to be having a positive effect on the rest of the fishery. Both of these programs should be continued.

The largemouth bass fishery continues to be the most important fishery at Lake Monroe. This fishery has been sustained largely through the voluntary practice of catch and release by Lake Monroe anglers. Provided this level of catch and release is continued, the 14-inch minimum size limit should be successful in protecting the fishery. Additional largemouth bass sampling has been incorporated into a general lake survey scheduled for 2001 and should provide additional insight into the health of the Lake Monroe largemouth bass fishery.

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Appendix 1. Estimated number of fish harvested, and largemouth bass, hybrid striped bass and walleye released at Lake Monroe by month during 2000.

Species	Month							
Harvested	April	May	June	July	Aug.	Sept.	Oct.	Total
Crappie	12,815	45,136	10,237	5,349	1,500	2,977	7,245	85,258
Bluegill	2,154	10,349	8,708	3,425	1,670	1,799	1,018	29,122
Yellow Bass	611	931	1,079	671	603	2,389	3,123	9,406
Hybrid striper	1,045	2,468	2,592	634	92	509	1,417	8,757
Channel catfish	726	1,343	758	897	238	86	83	4,131
Walleye	475	327	1,093	183	63	23	40	2,203
Largemouth bass	229	408	412	53	39	32	6	1,178
Other**	--	273	567	156	--	27	24	1,047
Released								
Largemouth bass	3,308	4,429	9,002	5,260	2,570	1,634	1,415	27,619
Hybrid striper	4,311	3,130	4,436	2,284	3,247	2,279	3,169	22,856
Walleye	319	1,080	2,511	548	324	213	203	5,198

**Includes redear sunfish, yellow perch, flathead catfish, blue catfish, freshwater drum and common carp.

Appendix 2. Summary of comments about Lake Monroe received by creel clerks during interviews in 2000.

Fishery

1. Need lower walleye size limit.
2. Need higher walleye size limit.
3. Need lower largemouth bass size limit.
4. Need higher largemouth bass size limit.
5. Need to stock largemouth bass.
6. Would like to see better largemouth bass management.
7. Would like to see a size limit for crappie.
8. Eliminate crappie bag limit.
9. Crappie are stunted.
10. Would like to see bluegill size limit.
11. Would like to have walleye stockings discontinued.
12. Everything should be catch and release.
13. Fish are too small.

General

1. Restrooms are inadequate.
2. Need trash receptacles.
3. Need fish cleaning station.
4. Need to fix roads.
5. Lake is too crowded.
6. Nice lake.

Enforcement

1. Too many tournaments on lake.
2. Need a higher night speed limit.